

**MONTANA DEPARTMENT OF ENVIROMENTAL QUALITY**

Permitting and Compliance Division

Water Protection Bureau

P.O. Box 200901

Helena, Montana 59620-0901

**Permit Fact Sheet**

**Montana Ground Water Pollution Control System (MGWPCS)**

PERMITTEE: HLH, LLC

PERMIT NUMBER: MTX000129

FACILITY NAME: Firelight Meadows Subdivision

FACILITY LOCATION: Southeast ¼, Section 2, Township 7 South, Range 3 East, Gallatin County

FACILITY CONTACT: Matthew Huggins, owner  
3281 Gardenbrook Lane  
Bozeman, Montana 59715  
Phone (406)570-0371

RECEIVING WATER: Class I Ground Water

NUMBER OF OUTFALLS: Three (3) for the purpose of fee determination

OUTFALL(S)/TYPE: 001A Subsurface Drainfield – “A” 136 chalets/duplexes/quadrplexes,  
from dose tank “A”  
002B Subsurface Drainfield – “B” (as above), from dose tank “B”  
003C Subsurface Drainfield – “C” 80 condominiums

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**I. PERMIT STATUS**

This statement of basis is for a permit renewal for Firelight Meadows Subdivision (FMS) pursuant to the Montana Ground Water Pollution Control System (MGWPCS). The previous permit was issued on January 9, 2002 (effective date was March 1, 2002), and expired on February 28, 2007. The permit was modified to reflect a transfer of ownership from J.M.P. Company Inc. to Firelight Meadows, LLC and re-issued on June 4, 2002. The current permittee, Firelight Meadows, LLC submitted a MGWPCS GW-1 and Form 1 application for permit renewal that was received by the Department March 26, 2007. On April 3, 2007, the Department received a notification for the transfer of ownership from Firelight Meadows, LLC to HLH, LLC. The Department requested supplemental information on April 26, 2007. A response was received on May 16, 2007. The application was determined to be complete on June 6, 2007.

This subdivision was subject to review and approval under the Montana Sanitation in Subdivision Act. The applicant submitted plans and specifications for review and received approval on May 8, 2001 (EQ#01-1005), which was subsequently re-issued on June 28, 2001 (EQ#01-1005A). A final

Certificate of Subdivision Plat Approval from the Department's subdivision section was issued on September 1, 2005 (EQ#06-1272).

This facility is subject to review and approval under the Public Water Supply Act (75-6-101, MCA et seq.). FMS received a PWSID of MT0004236 that was activated on August 19, 2002.

This facility is subject to the Montana Nondegradation Policy (75-5-303, MCA) and Administrative Rules (ARM 17.30.701, et seq.).

## II. FACILITY INFORMATION

### A. General

FMS is located on the west side of Ousel Falls Road in the Big Sky area. The subdivision consists of 136 "chalet" duplexes-quadrplexes, which includes a proposed daycare center that has not yet been built, and 80 condominiums, for a total of 216 individual residences.

### B. Wastewater Collection, Treatment, and Disposal

Wastewater from the 136 duplex-quadrplexes is collected in a community septic tank, which removes floatable and settleable solids. This wastewater is divided between two recirculation tanks creating two separate treatment systems that are identified as systems "A" and "B". Two separate recirculating sand filters (RSFs) provide Level II treatment to each system. Two dose tanks pressure-dose the two respective subsurface drainfields that discharge to shallow ground water (Attachment 1).

Wastewater from the 80 condominiums is treated in a separate system (e.g., system "C"). System "C" also receives Level II treatment in a RSF. A dose tank pressure-doses the treated effluent to a subsurface drainfield, which discharges to shallow ground water (Attachment 2).

Systems "A" and "B" each have a Neptune totaling flow meter. System "C" has two (2) Sensus totaling flow meters. Flows volumes from the two Sensus flow meters are added together for the "C" System. The original permit limits stipulate an average daily flow rate of 9,945 gallons per day (gpd) from system "A" and system "B," each, and 13,160 gpd from system "C", for a total average daily flow of 33,050 gpd.

## III. DESCRIPTION OF THE DISCHARGE

### A. Outfall Locations

The permit renewal authorizes the permittee to discharge residential strength wastewater from three RSF treatment systems to three subsurface drainfields (Outfall 001A, 002B, and 003C).

- Outfall 001A (System "A") is located in the northwest corner of the property, the southwest system, which is topographically higher than the northeast system.
- Outfall 002B (System "B") is located in the northwest corner of the property. The more northeasterly of the two systems.
- Outfall 003C (System "C") is located in the northeast corner of the property.

### B. Past Monitoring Data/Effluent Characteristics

The original permit limits were based on total inorganic nitrogen (TIN) which consists of nitrate + nitrite (as N) plus ammonia (as N) (see Part VII of this Fact Sheet). The technology-based, concentration-based permit limit in the effluent prior to discharge to the drainfields for TIN was 28 mg/L, with an annual average load of 3.6, 3.6, and 4.3 lb/day of TIN for Outfalls 001A, 002B, and 003C, respectively. The annual average total phosphorous load limits in the permit were not to exceed 1.15, 1.15, and 1.52 lb/day for Outfalls 001A, 002B, and 003C, respectively. The original permit load limits were calculated using the design capacity flow (gpd) for each outfall. The design capacity for Outfalls 001A and 002B is 15,300 gpd, each. The design capacity for Outfall 003C is 18,450 gpd.

The permittee has collected approximately 5 years (approximately 20 quarters) of analytical data according to composite effluent sampling techniques at each one of the three drainfield dose tanks as required in the permit (see Table 1, 2, and 3).

**Table 1: Outfall 001A Effluent Characteristics<sup>(1)</sup> for the POR from April 1, 2002 to March 31, 2007**

Parameter	Location	Units	Previous Permit Limit	Minimum Value	Maximum Value	Average Value	Number Of Samples
Flow, Quarterly Average	Effluent	gpd	9,945	13.3	5,760	2,894	14
Biological Oxygen Demand (BOD <sub>5</sub> )	Effluent	mg/L	(2)	<2	19	6.72	18
Total Suspended Solids (TSS)	Effluent	mg/L	(2)	<10	10	10	18
Fecal Coliform	Effluent	No./100ml	(2)	<1.0	140,000	13,058	18
Chloride	Effluent	mg/L	(2)	5	52	31.67	18
Ammonia, as N	Effluent	mg/L	(2)	<0.1	27.8	5.82	18
Nitrate + Nitrite, as N	Effluent	mg/L	(2)	0.10	32.0	7.75	18
Total Inorganic Nitrogen (TIN)	Effluent	mg/L	28	1.5	33.7	15.07	18
		lbs/day	3.6 <sup>(3)</sup>	0	8.33	0.77	15
Total Phosphorous (TP)	Effluent	mg/L	(2)	7.0	15.2	10.2	18
		lbs/day	1.15 <sup>(3)</sup>	0.63	0.86	0.13	15

## Footnotes:

(1) Conventional and nonconventional pollutants only, table does not include toxics.

(2) No limit in previous permit.

(3) Annual Average Load (lbs/day)

**Table 2: Outfall 002B Effluent Characteristics<sup>(1)</sup> for the POR from April 1, 2002 to March 31, 2007**

Parameter	Location	Units	Previous Permit Limit	Minimum Value	Maximum Value	Average Value	Number Of Samples
Flow, Quarterly Average	Effluent	gpd	9,945	360	31,306	6,515	19
Biological Oxygen Demand (BOD <sub>5</sub> )	Effluent	mg/L	(2)	<2	18	6.68	19
Total Suspended Solids (TSS)	Effluent	mg/L	(2)	<10	10	10	19
Fecal Coliform	Effluent	No./100ml	(2)	1.0	120,000	13,668	19
Chloride	Effluent	mg/L	(2)	12	52	31.9	18
Ammonia, as N	Effluent	mg/L	(2)	<0.1	19.7	4.44	19
Nitrate + Nitrite, as N	Effluent	mg/L	(2)	0.09	34.1	6.87	19
Total Inorganic Nitrogen (TIN)	Effluent	mg/L	28	5.7	34.2	12.13	18
		lbs/day	3.6 <sup>(3)</sup>	.017	12.28	1.29	17
Total Phosphorous (TP)	Effluent	mg/L	(2)	1.73	7.01	5.04	19
		lbs/day	1.15 <sup>(3)</sup>	0.005	1.47	0.39	17

## Footnotes:

(1) Conventional and nonconventional pollutants only, table does not include toxics.

(2) No limit in previous permit.

(3) Annual Average Load (lbs/day)

**Table 3: Outfall 003C Effluent Characteristics <sup>(1)</sup> for the POR from April 1, 2002 to March 31, 2007**

Parameter	Location	Units	Previous Permit Limit	Minimum Value	Maximum Value	Average Value	Number Of Samples
Flow, Quarterly Average	Effluent	gpd	13,160	504	34,848	4,966	18
Biological Oxygen Demand (BOD <sub>5</sub> )	Effluent	mg/L	(2)	<2	90	11.32	19
Total Suspended Solids (TSS)	Effluent	mg/L	(2)	<10	172	19.32	19
Fecal Coliform	Effluent	No./100ml	(2)	16	89,000	7,340.21	19
Chloride	Effluent	mg/L	(2)	16	46	33.32	19
Ammonia, as N	Effluent	mg/L	(2)	<0.1	29.6	8.27	19
Nitrate + Nitrite, as N	Effluent	mg/L	(2)	0.12	43.5	11.45	19
Total Inorganic Nitrogen (TIN)	Effluent	mg/L	28	5.6	43.5	20.27	19
		lbs/day	4.3 <sup>(3)</sup>	0	19.2	1.84	14
Total Phosphorous (TP)	Effluent	mg/L	(2)	3.05	9.74	6.31	19
		lbs/day	1.52 <sup>(3)</sup>	0	2.98	0.32	16
Footnotes:							
(1) Conventional and nonconventional pollutants only, table does not include toxics.							
(2) No limit in previous permit.							
(3) Annual Average Load (lbs/day)							

#### IV. SITE CHARACTERISTICS

##### A. Soil

In this area, the thickness of the topsoil ranges from 1 to 6 feet thick. Subsoils consist of sands, gravels, and clay to clay-mixes, which are poorly-sorted and consist of clay to gravel-size sediments.

##### B. Geology

Alluvial and glaciofluvial sediments dominate the Quaternary depositional environment in this area. The Thermopolis Shale (Cretaceous age) is the confining layer beneath the Quaternary deposits and may be several hundred feet thick. Beneath the shale is the Kootenai Sandstone. Regional tectonics in the area has deformed the original depositional orientation of these beds.

##### C. Hydrogeology

There are two aquifers in this area. The shallow, unconfined aquifer is in alluvial and glaciofluvial deposits. Well logs in the area show this shallow zone(s) of unconsolidated material to be mostly angular to sub-angular gravel with varying amounts of sand, cobbles, and some silt. Thicknesses range from 10 to 68 feet in the Big Sky area.

The current depth to shallow ground water at this site ranges from 34 to 43 feet below the top of the well casing (TOC), as measured in monitoring well MW1A, located 140 feet hydraulically downgradient from Outfall 003C. The depth to ground water fluctuates seasonally and is reported to be highest during the spring and early summer months.

The confined aquifer lies beneath the regional shale unit (Thermopolis Shale). According to deeper well logs in the area, the deep confined aquifer is associated with the sandstones layers of the Kootenai Sandstone Formation which is interbedded with gray shale. The sandstones are encountered at approximately 125 feet deep. They vary in density with depth from soft, to dense and fractured and are generally prolific aquifers. Sandstones are encountered as deep as 280 feet, according to deeper well log data available in this area. In some areas beneath the unconsolidated deposits, siltstones have been described as part of the Kootenai Formation.

#### D. Hydrology

The hydraulic conductivity is 245 ft/day based on the original aquifer pump test conducted at Well #3 (C & H Engineering, 2000). Well #3 is a shallow (total depth is 68 feet) irrigation well located approximately 220 feet hydraulically downgradient from Outfalls 001A and 002B. The hydraulic gradient of 0.05 ft/ft was originally determined using static water levels (SWLs) measured in June 2000 from three onsite wells. Based on that SWL data, the direction of shallow ground water flow was determined to be S79°E.

The nearest surface water is the South Fork of the West Fork of the Gallatin River. The river is 2,000 feet hydraulically downgradient from Outfall 003C.

#### V. RECEIVING WATER

##### A. Water-Use Classification and Applicable Water Quality Standards

The average nitrate + nitrite (as N) concentration in the shallow ground water hydraulically downgradient from the Outfall 003C is 1.84 mg/L. The permittee has collected 5 years (20 quarters) of ground water monitoring data from monitoring well MW1A, which is located approximately 140 feet in a general downgradient direction from Outfall 003C (see Table 4).

Well #3 is a shallow (screened from 58 to 68 feet) irrigation well located upgradient from Outfall 003C, as well as hydraulically downgradient from Outfall 001A and 002B. Well #3 was sampled prior to permitting on January 8, 2001. The nitrate + nitrite (as N) concentration was detected at 1.6 mg/L. Well #3 was sampled again on July 2, 2007. The nitrate + nitrite (as N) concentration was measured at 2.66 mg/L. Based on this limited sampling history, the average nitrate + nitrite (as N) concentration in Well #3 is 2.13 mg/L. Analytical data from these wells provide a range in nitrate + nitrite (as N) concentration from 1.84 to 2.13 mg/L. This data indicates the ground water quality characterization at this site is representative of the overall quality of the shallow aquifer in the area. Upgradient from this site, bedrock subcrops beneath the topsoil.

The average specific conductivity based on the MW1A data-set is 605 umhos/cm. The specific conductivity was reported at 522 umhos/cm in Well #3 (sample collected 7/2/07).

<b>Table 4: Monitoring Well (MW1A) Ground Water Characteristics<sup>(1)</sup> for the POR from April 1, 2002 to March 31, 2007</b>							
Parameter	Location	Units	Previous Permit Limit	Minimum Value	Maximum Value	Average Value	Number Of Samples
Static Water Level	Ground Water	feet	(2)	Low water = 43'	High water = 34'	40.61	19
Fecal Coliform	Ground Water	No./100ml	<1	<1	2	1.7	20
Specific Conductivity	Ground Water	umhos/cm	1,000	520	764	605	20
Chloride	Ground Water	mg/L	(2)	3	34	9.8	20
Ammonia, as N	Ground Water	mg/L	(2)	<0.05	<0.1	0.1	20
Nitrate + Nitrite, as N	Ground Water	mg/L	7.5	<0.05	5.17	1.84	20
Footnotes: (1) Conventional and nonconventional pollutants only, table does not include toxics. (2) No limit in previous permit.							

Based on the average specific conductivity, the receiving water for Outfall 001 is Class I ground water. Class I ground water has a specific conductivity of less than or equal to 1,000  $\mu\text{mhos/cm}$  at 25 degrees Centigrade, as defined by ARM 17.30.1006(1). According to ARM 17.30.1006(1)(a), the quality of Class I ground water must be maintained so that these waters are suitable for public and private water supplies, culinary and food processing, irrigation, commercial and industrial purposes, drinking water for livestock and wildlife, with little or no treatment. Human health standards listed in DEQ Circular 7 (February 2006) apply to concentrations of dissolved substances in Class I ground water.

The applicable ground water quality standards and nondegradation significance criteria are included in Table 5.

**Table 5. Applicable Water Quality Standards and Nondegradation Significance Criteria**

Parameter	DEQ Circular 7 Human Health Ground Water Standards	Nondegradation Significance Criteria in Ground Water for Level II Treatment
Nitrate (as N)	10 mg/L	7.5 mg/L
Total Phosphorus	no standard	50 year breakthrough <sup>(1)</sup> , mg/L
E-Coli Bacteria	<1 organism per 100 ml	<1 organism per 100 ml

<sup>1</sup> The phosphorus significance criteria is listed in ARM 17.30.715(1)(e): "changes in concentration of total inorganic phosphorus in ground water if water quality protection practices approved by the department have been fully implemented and if an evaluation of the phosphorus adsorptive capacity of the soils in the area of the activity indicates that phosphorus will be removed for a period of 50 years prior to a discharge to any surface waters."

## VI. MIXING ZONE

As stated in Part I of this Fact Sheet, the permittee has been approved to discharge all wastewater from Outfall 001A, 002B, and 003C, since the initial permit became effective on March 1, 2002. In the application form for the permit renewal, the permittee has requested a renewal of the originally permitted three standard, 500-foot ground water mixing zones (ARM 17.30.517). However, the Department has determined that the three mixing zones will need to be modified in the permit renewal [see ARM 17.30.515(1)(d)]. The width of the mixing zones for each outfall (3) at this site will be re-delineated to include only the source, not the replacement areas [see ARM 17.30.517(1)(d)(iii)(B)]. The lengths shall be limited due to the potential for impairment of existing or anticipated uses of the receiving water [see ARM 17.30.505(1)(c)].

Water quality impairment issues over the first permit cycle (5 years) include, but are not limited to, sporadic permit effluent limit exceedances (TIN) generally associated with the operation and maintenance of the RSFs, and the highly variable nitrate + nitrite (as N) concentrations detected in the shallow ground water downgradient from Outfall 003C in monitoring well MW1A [see Discharge Monitoring Reports (DMRs)].

The ground water mixing zone for Outfall 003C will be modified to 140 feet long due to the potential for seasonal fluctuations in the direction of ground water flow and the resulting cumulative effects (nitrate, as N) associated with multiple ground water mixing zones (Outfalls 001A and 002B) located within 500 feet of this outfall [see ARM 17.30.517(1)(d)(ix)]. This well (MW1A) is located along the southeast property boundary of the development. The adjacent property owner will not agree to the installation of a monitoring well on his property. Based on all of the above information, the length of the mixing zone for Outfall 003C will be modified to 140-feet so that monitoring of the ground water quality at the end of the mixing zone can be accomplished.

In the original permit, ground water monitoring for Outfalls 001A and 002B at the boundary of the original 500-foot mixing zones was not required. On August 26, 2007, there were reports/complaints regarding sewage observed on the ground surface in the area of the community septic tank for Outfalls 001A and 002B. The ground water mixing zones for Outfalls 001A and 002B will each be modified to 220 feet long for the permit renewal. A shallow well (Well #3) is already in place at the 220-foot distance downgradient and midway between the two outfalls. This is the most optimal location for monitoring based on the existing structures in the area. This well will serve as a monitoring point for the hydraulically downgradient boundary of the modified mixing zone [see ARM 17.30.505(1)(f)].

In granting a mixing zone, the Department must comply with the ground water mixing zone rules pursuant to ARM Title 17, Chapter 30, Subchapter 5. The shape of the mixing zones are determined using the active subsurface drainfield dimensions and information on water table elevations and topography.

The shallow ground water flow direction is approximately S79°E and the hydraulic gradient is 0.05 ft/ft (see part IV.D of this statement of basis for details).

In the vicinity of Outfall 003C, the average concentration of nitrate + nitrite (as N) in the shallow ground water is 1.84 mg/L (see Part V of this statement of basis). Downgradient from Outfalls 001 and 002 (Well #3), the average nitrate + nitrite (as N) concentration is 2.13 mg/L. The concentration of

pollutants has been estimated based on a mass balance calculation at the downgradient boundary of each of the proposed ground water mixing zones. The Department is granting three separate ground water mixing zones for nitrate (as N).

## VII. PROPOSED EFFLUENT LIMITS

Data show recirculating sand filter (RSF) wastewater treatment systems produce a high quality effluent, and are considered to be a Level II treatment according to ARM 17.30.702(11). A Level II system must provide at least a 60 percent removal of total nitrogen (TN) in the raw wastewater or an effluent TN concentration of 24 mg/L or less beneath the drainfield [ARM 17.30.702(11)]. The Department has established that a properly installed, operated and maintained RSF wastewater treatment system meets the definition of a Level II system.

The original permit uses a technology-based effluent limit (TBEL) of 28 mg/L limit for total inorganic nitrogen (TIN), which is a combination of nitrate + nitrite (as N) and ammonia. The permit limit is being changed in the renewed permit from 28 to 26 mg/L because the 28 mg/L was calculated incorrectly by assuming that 7% nitrogen reduction in the drainfield was 7% of the raw wastewater concentration (60 mg/L) rather than the correct concentration of the effluent entering the drainfield. The limit is also being changed in the renewed permit from TIN to TN to account for the organic nitrogen in the effluent which is able to convert to nitrate in the subsurface. TIN does not account for the organic fraction of nitrogen in the effluent.

Therefore, the renewed permit limit will be for TN and the permit limit will be set at 26 mg/L in the effluent, prior to discharge to the subsurface drainfield because an additional 7% of nitrogen removal (through treatment) is assumed to occur within the drainfield providing a final TN concentration discharged to the ground water of 24 mg/L. Based on the performance of the system, the TBELs for TN and total phosphorous (TP) are set forth in Table 6.

**Table 6. Technology-Based Effluent Limits for Outfall 001, 002 and 003, separately  
(at the dose tank prior to discharge to the subsurface drainfields)**

Parameter	Daily Maximum <sup>(1)</sup> Concentration (mg/L)
Total Nitrogen, as N (TN) <sup>(2)</sup>	26
Total Phosphorous, as P (TP)	NA

(1) See definitions, Part V. of the permit.

(2) Total Nitrogen (TN) is the sum of nitrate + nitrite (as N) and total Kjeldahl nitrogen (as N).

NA = Not Applicable

## VIII. PROPOSED WATER QUALITY-BASED EFFLUENT LIMITS

The Montana Water Quality Act requires that a discharge to state waters shall not cause a violation of water quality standards. Water quality limitations must be established in permits to control all pollutants or pollutant parameters that are or may be discharged at a level which will cause, have reasonable potential to cause or contribute to an excursion above any state water quality standard. The permittee must comply with Montana Numeric Water Quality Standards included in DEQ Circular 7 (February 2006) and the protection of beneficial uses (ARM 17.30.1006).

## A. Nitrate

The Class I ground water is considered high quality water and is subject to Montana's Nondegradation Policy (75-5-303, MCA). The applicable ground water standard is based on nondegradation, with a nitrate concentration limit of 7.5 mg/L [ARM 17.30.715 (1)(d)(iii)] at the end of the each ground water mixing zone (Outfall 001A and 002B, each have a 220-foot mixing zone, Outfall 003C has a 140-foot mixing zone).

The total nitrogen (TN) concentration is the sum of nitrate plus nitrite, as nitrogen (N) plus Total Kjeldahl Nitrogen (as N). The Department assumes all the nitrogen discharged to the drainfield in the effluent is converted to nitrate, as (N).

For Outfalls 001 and 002, separately, the allowable discharge concentration is derived from the mass balance water quality equation which considers dilution and background concentration of the receiving water (EPA, 2000).

$$C_2 = \frac{C_3(Q_1 + Q_2) - C_1 Q_1}{Q_2}$$

$C_2 = 110 \text{ mg/L}$

$C_1$  = ambient average ground water concentration, is 2.13 mg/L

$C_2$  = allowable discharge concentration (TN) beneath the drainfield in mg/L

$C_3$  = ground water concentration limit for pollutant (from DEQ Circular 7 or other appropriate water quality standard) at the end of the mixing zone is 7.5 mg/L, instantaneous (no single sample shall exceed)

$Q_1$  = ground water volume is 25,449 ft<sup>3</sup> / day

$Q_2$  = maximum flow of discharge (average daily flow of system is 1,330 ft<sup>3</sup> /day)

The volume of ground water that will mix with the discharge ( $Q_1$ ) is estimated using Darcy's equation:  $Q_1 = K I A$ . The calculated value of  $Q_1$  is 25,449 ft<sup>3</sup>/day for the mixing zone; assuming an aquifer  $K$  value of 245 ft/day from the ground water studies in the area, a measured gradient of 0.05 ft/ft, and a cross sectional area of flow at the downgradient boundary of the 220-foot mixing zone of 2,077.5 ft<sup>2</sup>.

The average daily flow of the wastewater disposal system is 9,945 gpd, or 1,330 ft<sup>3</sup>/day. The nitrate (as N) concentration must not exceed 7.5 mg/L at the end of each 220-foot mixing zone. The average concentration of nitrate-nitrogen in the shallow ground water is 2.13 mg/l ( $C_1$ ). It is assumed that the entire TN load in the effluent converts to nitrate (as N) and enters the ground water.

As discussed in Part VII, nitrate reduction of approximately 7 percent is assumed to occur beneath the drainfield. Therefore, to discharge a TN concentration of 110 mg/L below the drainfield, the effluent limit from the RSF system at the dose tank prior to discharge to the subsurface drainfields is calculated at 118 mg/L of TN.

$$110 \text{ mg/L} (.07) = 7.7 \text{ mg/L}$$

Assumed nitrate reduction beneath the drainfield.

$$110 \text{ mg/L} + 7.7 \text{ mg/L} = 117.7 \text{ mg/L}$$

Maximum concentration of TN at the dose tank, prior to discharge to the subsurface drainfield (Outfall 001A and 002B, each separately).

The calculated effluent concentration of TN must not exceed 118 mg/L at the average daily flow in order to maintain a concentration that is less than the state water quality standard of 7.5 mg/L for nitrate plus nitrite (as N) in the ground water at the mixing zone (Part VI) boundary for each outfall (001A and 002B). The WQBEL will be expressed as a load (lbs/day) based on the average daily flow of the system (9,945 gpd) and the calculated maximum concentration as follows:

$$\begin{aligned} \text{Load limit (lbs/day) per outfall} &= \text{effluent flow rate (gpd)} \times \text{daily maximum concentration (mg/L)} \times (8.34 \times 10^{-6}) \\ \text{Load limit (lbs/day) per outfall} &= (9,945 \text{ gpd}) \times (118 \text{ mg/L}) \times (8.34 \times 10^{-6}) \\ \text{Load limit (lbs/day) per outfall} &= 9.8 \text{ lbs/day} \end{aligned}$$

Original permit load limits were calculated based on the design flow, which is 15,300 gpd for Outfalls 001A and 002B separately, and a TIN effluent limit of 28 mg/L (refer to Part VII of this Fact sheet).

For Outfalls 003, the allowable discharge concentration is derived from the mass balance water quality equation which considers dilution and background concentration of the receiving water (EPA, 2000).

$$C_2 = \frac{C_3(Q_1 + Q_2) - C_1 Q_1}{Q_2}$$

$$C_2 = 72 \text{ mg/L}$$

$C_1$  = ambient average ground water concentration, is 1.84 mg/L

$C_2$  = allowable discharge concentration (TN) beneath the drainfield in mg/L

$C_3$  = ground water concentration limit for pollutant (from DEQ Circular 7 or other appropriate water quality standard) at the end of the mixing zone is 7.5 mg/L, instantaneous (no single sample shall exceed)

$Q_1$  = ground water volume is 20,121 ft<sup>3</sup> / day

$Q_2$  = maximum flow of discharge (average daily flow of system is 1,759.36 ft<sup>3</sup> /day)

The volume of ground water that will mix with the discharge ( $Q_1$ ) is estimated using Darcy's equation:  $Q_1 = K I A$ . The calculated value of  $Q_1$  is 20,121 ft<sup>3</sup>/day for the mixing zone; assuming an aquifer K value of 245 ft/day from the ground water studies in the area, a measured gradient of 0.05 ft/ft, and a cross sectional area of flow at the downgradient boundary of the 140-foot ground water mixing zone of 1,642.5 ft<sup>2</sup>.

The average daily flow of the wastewater disposal system is 13,160 gpd, or 1,759.36 ft<sup>3</sup>/day. The nitrate (as N) concentration must not exceed 7.5 mg/L at the end of the mixing zone. The average concentration of nitrate-nitrogen in the shallow ground water is 1.84 mg/l ( $C_1$ ). It is assumed that the entire TN load in the effluent converts to nitrate (as N) and enters the ground water.

As discussed in Part VII, nitrate reduction of approximately 7 percent is assumed to occur beneath the drainfield. Therefore, to discharge a TN concentration of 72 mg/L below the drainfield, the effluent

limit from the RSF system at the dose tank prior to discharge to the subsurface drainfields is calculated at 77 mg/L of TN.

$$\begin{aligned}72 \text{ mg/L } (.07) &= 5.04 \text{ mg/L} \\72 \text{ mg/L} + 5.04 \text{ mg/L} &= 77.04 \text{ mg/L}\end{aligned}$$

Assumed nitrate reduction beneath the drainfield.  
Maximum concentration of TN at the dose tank, prior to discharge to the subsurface drainfield (Outfall 003).

The calculated effluent concentration of TN must not exceed 77 mg/L at the average daily flow in order to maintain a concentration that is less than the state water quality standard of 7.5 mg/L for nitrate plus nitrite (as N) in the ground water at the mixing zone (Part VI) boundary for Outfall 003C. The WQBEL will be expressed as a load (lbs/day) based on the average daily flow of the system (13,160 gpd) and the calculated maximum concentration as follows:

$$\begin{aligned}\text{Load limit (lbs/day) per outfall} &= \text{effluent flow rate (gpd)} \times \text{daily maximum concentration (mg/L)} \times (8.34 \times 10^{-6}) \\ \text{Load limit (lbs/day) per outfall} &= (13,160 \text{ gpd}) \times (77 \text{ mg/L}) \times (8.34 \times 10^{-6}) \\ \text{Load limit (lbs/day) per outfall} &= 8.45 \text{ lbs/day}\end{aligned}$$

Original permit load limits were calculated based on the design flow, which is 18,450 gpd for Outfall 003C, and a TIN effluent limit of 28 mg/L (refer to Part VII of this Fact sheet).

The WQBELs for the permit renewal are summarized in Table 7 and 8.

## B. Phosphorus

A concentration of 10.6 mg/L of total phosphorous (TP) is consistent with the concentration found in residential wastewater. Therefore, the estimated load using average daily flow from Outfalls 001A and 002B is 0.88 pounds per day (lbs/day) per outfall. The estimated load from Outfall 003C is 1.16 lbs/day.

More precisely, phosphorus is removed mainly through soil sorption processes, which are slow and vary based on soil composition. TP limitations are imposed to ensure that the quality of the effluent meets the nondegradation significance criteria prior to discharge into any surface water [ARM 17.30.715(1)(e)]. The effluent limits do not include a concentration limit for phosphorus because the method used to determine compliance is the 50-year breakthrough analysis. The 50-year breakthrough nondegradation criterion is based on the amount of soil available to adsorb the phosphorus between the discharge point and the surface water using the average load of phosphorus from the wastewater source.

No part of the subsurface wastewater treatment systems overlap in the direction of ground water flow (DEQ, 2005) so, there are no cumulative effects from potential phosphorous loading in the ground water at this site.

Based on the ground water flow direction of S79°E at this site, a phosphorous breakthrough analysis shows the breakthrough time to the surface water (South Fork of the West Fork of the Gallatin River) from Outfall 001A and 002B separately, is 64.4 years. Phosphorous breakthrough from Outfall 003C is 54 years. Therefore, the discharge from these outfalls is considered nonsignificant degradation pursuant to the criteria of ARM 17.30.715(1)(e). The effluent limit for the TP load discharged to Outfall 001A and 002B (separately) is 418.6 lbs/yr or 1.15 lbs/day. The effluent limit for the TP load discharged to

Outfall 003C is 515.2 lbs/yr or 1.41 lbs/day. The original TP load for Outfall 003C (553.8 lbs/yr and 1.52 lbs/day) was based on 86 condominiums, instead of 80 units.

### C. E-Coli Bacteria

The Department is not granting a mixing zone for E-coli bacteria. A properly sited and operated drainfield should remove most, if not all, of the pathogenic bacterial indicators within 2 to 3 feet of the drainfield's infiltrative surface (USEPA, 2002). The E-coli water quality standard is <1 organism per 100 ml in the ground water (DEQ Circular 7, 2/2006). Shallow ground water monitoring for E-coli bacteria at the hydraulically downgradient edge of the subsurface drainfields will not be required at this time.

However, based on the following site-specific criteria, E-coli bacteria shall continue to be monitored in the shallow ground water at the end of the modified (140-foot) mixing zone for Outfall 003C at monitoring well MW1A in the permit renewal. E-coli bacteria shall also be monitored in the shallow ground water at the end of the two adjacent 220-foot mixing zones one for Outfalls 001A and one for Outfall 002B at monitoring well Well #3 in the permit renewal.

- Ground water samples from MW1A have been analyzed on a quarterly frequency for fecal coliform bacteria as a requirement of the original permit. The permit renewal will require ground water monitor wells (MW1A and Well #3) to be sampled and analyzed quarterly for E-Coli bacteria, per DEQ Circular 7 (2/2006) Human health Standards.
- Based on the historic ground water analytical data from MW1A (located 140 feet approximately downgradient from Outfall 003C), 16 of the 20 samples collected and analyzed quarterly over a 5-year period did not detect organisms equal to or greater than 1 organism per 100 milliliters (DEQ Circular 7, 2/2006). Three samples had higher detection limits, but no organisms were detected at method detection limits of less than 10, 4, and 2 organisms/100 ml. One sample detected measurable organisms at 2 organisms/100 ml, which was reported for the first quarter of 2003. Laboratory analysis methodology accounts for the variable detection limits. One analysis of 2 organism/100 ml is not a significant detection over a total of nearly 5 years of non-detects.
- The length of the mixing zones have been modified for this permit cycle (see Part VI of this Fact Sheet). Well #3 and MW1A will be used to monitoring the quality of the shallow ground water hydraulically downgradient from these outfalls, which will be satisfactory to protect human health and the environment, unless corrective action becomes necessary (see Part X.D. of this Fact Sheet).
- A recent (August-September 2007) community septic tank back-up onto the ground surface. Although the sewage on the ground surface was contained to a small area, there is a potential for infiltration through the soils and subsoils into the shallow ground water. Ground water monitoring at the modified mixing zone well (Well#3) should detect any impacts from this sewage back-up.

Under normal operations, systematic pressure-dosing of the drainfields minimizes saturated conditions and maximizes the die-off rate in the natural sediments. The subsurface drainfields discharge effluent approximately 2 to 4 feet below the ground surface. The average depth to ground water in MW1A is 40.61 feet below the top of the well casing. This provides between 32 to 41 feet of unsaturated sediments where treatment may occur naturally before discharging to the ground water.

#### D. BOD<sub>5</sub> and TSS

BOD<sub>5</sub> and TSS are monitored for wastewater treatment system efficiency to ensure the effective removal of biological material and that the proper aerobic biological processes are being maintained. There are no numeric ground water quality standards for BOD and TSS, however according to ARM 17.30.1006(1)(b)(ii), the beneficial uses for a Class I ground water must be maintained. BOD and TSS are not subject to nondegradation unless they have a reasonable potential to affect a beneficial use based on the significance criteria for BOD and TSS, which are narrative [ARM 17.30.715 (1)(g) and DEQ Circular 7].

**Table 7. Water Quality-Based Effluent Limits for Outfall 001A and 002B, separately  
(at each the dose tank prior to discharge to the subsurface drainfields)**

Parameter	Daily Maximum <sup>(1)</sup> Concentration (mg/L)	90-Day Average Load <sup>(1)</sup> (pounds per day)
Total Nitrogen, as N [TN]	118	9.8
Total Phosphorus, as P [TP]	NA	1.15

(1) See definitions, Part V of the permit  
NA Not Applicable

**Table 8. Water Quality-Based Effluent Limits for Outfall 003C  
(at the dose tank prior to discharge to the subsurface drainfields)**

Parameter	Daily Maximum <sup>(1)</sup> Concentration (mg/L)	90-Day Average Load <sup>(1)</sup> (pounds per day)
Total Nitrogen, as N [TN]	77	8.45
Total Phosphorus, as P [TP]	NA	1.41

(1) See definitions, Part V of the permit  
NA Not Applicable

#### IX. PROPOSED FINAL EFFLUENT LIMITS

The proposed effluent limitations for Outfall 001A and 002B are summarized in Table 9. The proposed effluent limitations for Outfall 003C are summarized in Table 10. These limits are based on the more restrictive of the technology and water quality criteria discussed in previous sections. The final proposed effluent concentration limit for TN is technology-based, relating to the expected performance of the RSF systems and the subsurface drainfields with proper operation and maintenance. The concentration limit is proposed to ensure the system operates at the Level II requirement with an effluent concentration of TN at Outfall 001A, 002B and 003C (individually) not to exceed 24 mg/L, as specified in ARM 17.30.702(11).

The final proposed effluent load limit for the renewed permit is based on the average daily flow and the WQBEL concentration. Original effluent TIN permit limits were calculated based on the design capacity for each outfall. The load limit for TN is based on complying with the nondegradation criteria of 7.5 mg/L for nitrate (as N) in ground water.

The effluent limit for TP is water quality-based as determined according to nondegradation significance criteria. The water quality-based effluent load limit considers the assimilative capacity of the soil system to estimate the maximum load of phosphorus discharged to the ground water without exceeding the 50-year breakthrough. The annual average phosphorous load for Outfall 003C was calculated based

on 86 condominium units in the original permit (1.52 lbs/day). The renewed permit TP load limit for Outfall 003C is calculated based on 80 units (1.41 lbs/day). The 90-day average load limit required in the permit renewal will provide protection for the surface and ground water.

The effluent limits in Table 9 apply to the treated effluent at each dose tank prior to discharge to the subsurface drainfields as shown in Attachment 1 (Outfalls 001A and 002B).

**Table 9. Numeric Effluent Limits for Outfall 001A**

Parameter	Daily Maximum Concentration <sup>(1)</sup> (mg/L) per Outfall	90-Day Average Load <sup>(1)</sup> (pounds per day) per Outfall
Total Nitrogen, as N (TN) <sup>(2)</sup>	26	9.8
Total Phosphorus, as P (TP)	NA	1.15

<sup>(1)</sup> See definitions, Part V of the permit.

<sup>(2)</sup> Total Nitrogen (TN) is the sum of nitrate + nitrite (as N) and total Kjeldahl nitrogen (as N).

NA Not Applicable

Other Discharge Limitations:

The average daily flow of effluent discharged to Outfall 001A shall not exceed 9,945 gpd (MGWPCS Permit, January 2002).

**Table 10. Numeric Effluent Limits for Outfall 002B**

Parameter	Daily Maximum Concentration <sup>(1)</sup> (mg/L) per Outfall	90-Day Average Load <sup>(1)</sup> (pounds per day) per Outfall
Total Nitrogen, as N (TN) <sup>(2)</sup>	26	9.8
Total Phosphorus, as P (TP)	NA	1.15

<sup>(1)</sup> See definitions, Part V of the permit.

<sup>(2)</sup> Total Nitrogen (TN) is the sum of nitrate + nitrite (as N) and total Kjeldahl nitrogen (as N).

NA Not Applicable

Other Discharge Limitations:

The average daily flow of effluent discharged to Outfall 002B shall not exceed 9,945 gpd (MGWPCS Permit, January 2002).

The effluent limits in Table 11 apply to the treated effluent at the dose tank prior to discharge to the subsurface drainfield as shown in Attachment 2 (Outfall 003C).

**Table 11. Numeric Effluent Limits for Outfall 003C**

Parameter	Daily Maximum Concentration <sup>(1)</sup> (mg/L) per Outfall	90-Day Average Load <sup>(1)</sup> (pounds per day) per Outfall
Total Nitrogen, as N (TN) <sup>(2)</sup>	26	8.45
Total Phosphorus, as P (TP)	NA	1.41

<sup>(1)</sup> See definitions, Part V of the permit.

<sup>(2)</sup> Total Nitrogen (TN) is the sum of nitrate + nitrite (as N) and total Kjeldahl nitrogen (as N).

NA Not Applicable

#### Other Discharge Limitations:

The average daily flow of effluent discharged to Outfall 003 shall not exceed 13,160 gpd (MGWPCS Permit, January 2002).

### X. MONITORING REQUIREMENTS

#### A. Influent Monitoring

No influent monitoring will be required at this time.

#### B. Effluent Monitoring

Effluent monitoring is essential to ensure the effective treatment and consistency of the wastewater discharged from the facility. The effluent limits are established to protect the ground water from a change in water quality that would cause degradation (ARM 17.30.715) or cause a change in beneficial use [ARM 17.30.1006(1)(a)]. Samples or measurements shall be representative of the volume and nature of the monitored discharge at each of the three outfalls, individually.

Effluent monitoring/sampling shall be conducted by collecting a composite sample from each wastewater treatment system dose tank that is representative of the discharge prior to discharging to each subsurface drainfield (Outfall 001A through 003C) (see Attachment 1 and 2). Each dose tank sample shall be submitted to the laboratory for analysis of all of the parameters in Table 12.

The permittee shall monitor the effluent at each outfall (Outfall 001A, 002B, and 003C, separately) for the parameters in Table 12 and at the frequency and with the type of measurement and sampling as indicated. If no discharge occurs during the entire monitoring period, it shall be stated in a Discharge Monitoring Report (DMR) that “no discharge” occurred.

**TABLE 12. Parameters To Be Monitored in the Effluent at Outfall 001A, 002B, and 003C, separately**

Parameter, units	Frequency	Sample Type <sup>(1)</sup>
Effluent Flow Rate, gpd <sup>(2)</sup>	Continuous	Continuous <sup>(1)</sup>
Total Suspended Solids,(TSS), mg/L	Quarterly	Composite
Biological Oxygen Demand (BOD <sub>5</sub> ), mg/L	Quarterly	Composite
Total Kjeldahl Nitrogen, as N (TKN), mg/L	Quarterly	Composite
NO <sub>3</sub> +NO <sub>2</sub> (as N), mg/L	Quarterly	Composite
Total Phosphorus, as P (TP), mg/L	Quarterly	Composite
Total Nitrogen, as N (TN), mg/L	Quarterly	Calculated <sup>(3)</sup>
Total Nitrogen, as N (TN), lb/d	Quarterly	Calculated <sup>(4)</sup>
Total Phosphorus, as P (TP), lb/d	Quarterly	Calculated <sup>(4)</sup>

(1) See definitions, Part V of the permit

(2) To be measured by a totalizing flow meter at the dose vault

(3) Total Nitrogen, as N = nitrate + nitrite, (as N) + total Kjeldahl nitrogen, (as N)

(4) See definition of “quarterly average” in Part V of the permit.

The 90-day average load for TN and TP are the sum of the calculated loads for each TN and TP sample collected within the 90-day period, divided by the number of samples collected and analyzed for TN and TP.

Over the past 5 years (18 to 20 quarterly samples) effluent samples have been analyzed for fecal coliforms as required in the original permit. This will not be a required analyte in the effluent sample analysis in the renewed permit.

The effluent measurement method shall be either by recorder or totalizing flow meter; dose counts or pump run-times will not be accepted for these wastewater systems. The permittee has stated in the permit application for permit renewal that the method of flow monitoring at Outfalls 001A and 002B is a totalizing Neptune flow meter after each respective dose tank, prior to each outfall (see Attachment 1). The method of flow monitoring at Outfall 003C is two totalizing Sensus flow meters following the dose tank and prior to discharging to the subsurface drainfield (see Attachment 2). The permittee shall report the flows for each outfall separately (Outfall 001A, 002B, and 003C) based on the average daily flow in gpd for each quarter.

### C. Ground Water Monitoring

Ground water monitoring was required in the original permit for this facility. The renewed permit will require additional ground water monitoring. Ground water monitoring requirements in the permit renewal are based on the following site-specific criteria.

- The depth to shallow ground water beneath the site ranges from a high of 34 feet below the top of the well casing (TOC) in the third quarter of 2002, to a low SWL of 43 feet below the TOC (first quarter of 2007). The average depth to shallow ground water is 40.61 feet below the TOC (see Table 4).
- Over the period of the first permit cycle operation and maintenance practices have been reactionary instead of pro-active. Evidence of this is demonstrated in the concentration-based

effluent limits for TIN, which have been exceeded and later reduced after the RSFs have been cleaned-out.

- More recently (Hovde, October 2007) poor operation and maintenance practices regarding the lack septic tank filter cleaning caused sewage back-ups onto the ground surface at Outfalls 001 and 002 (combined community septic tank).
- The specific conductivity in the shallow ground water in MW1A has increased by nearly 100 umhos/cm over the first permit cycle (i.e., 5 years).
- Although Outfalls 001A and 002B are not directly aligned in a hydraulically downgradient direction with 003C, even minimal seasonal variations in the direction of ground water flow could create the potential for cumulative effects of nitrate (as N) at Outfall 003C.
- The lengths of the ground water mixing zones for each outfall (001A, 002B, and 003C) have been modified in the permit renewal (see Part VI of this Fact Sheet).
- The South Fork of the West Fork of the Gallatin River is approximately 2,000 feet hydraulically downgradient from this facility.

To date, shallow ground water monitoring has been a permit requirement at monitoring well MW1A. This monitoring well is located 140 feet approximately downgradient from Outfall 003C. MW1A was installed in anticipation that cumulative effects of nitrate (as N) in the shallow ground water from all three drainfields could be observed/monitored at this one well location. MW1A will continue to be sampled on a quarterly frequency to monitor the quality of the ground water for nitrate (as N) hydraulically downgradient from the boundaries of the modified (140 feet) ground water mixing zone for Outfall 003C.

At the present time, there is no shallow ground water monitoring requirement for Outfalls 001A and 002B. A shallow ground water monitoring will be required in the permit renewal hydraulically downgradient from Outfalls 001 and 002, since these mixing zones are located within 500 feet of each other, and within 500 feet of the mixing zone for Outfall 003

Currently, there is already a shallow well located approximately 220 feet hydraulically downgradient in a S79°E direction from Outfalls 001A and 002B. This is Well #3, which is an existing a shallow irrigation well. In the permit renewal, this well will be required to be sampled on a quarterly frequency to monitor the quality of the shallow ground water hydraulically downgradient from Outfall 001A and 002B. Water for irrigation purposes will be supplied from a much deeper well that is located nearby Well #3. The shallow well (Well #3) will only receive limited use during the third quarter of each year.

MW1A and Well #3 are both screened in the shallow aquifer. MW1A is screened from 35 to 55 feet in gravel, rocks and clay mix. Well #3 is screened from 58 to 68 feet in gravels.

Since disinfection has never been installed at these wastewater treatment systems, monitoring for E-coli bacteria in the ground water at the end of the ground water mixing zones will be required (see Part VII.C. of this statement of basis). In the original permit, fecal coliform bacteria was a sampling requirement for samples collected from MW1A.

The parameters to be monitored and the sampling frequency for monitoring well MW1A and Well #3 are given in Table 13. Each well is to be sampled and analyzed separately. For DMR purposes Well #3 will be referred to by the Department as MW2A.

**Table 13. Ground Water Monitoring Parameters for Monitoring Wells MW1A and MW2A, Each Well is to be Sampled and Analyzed Separately.**

Parameter, units	Frequency	Sample Type <sup>(1)</sup>
Static Water Level (SWL), feet below top of casing	Quarterly	Measured
Nitrate + Nitrite (as N), mg/L	Quarterly	Grab
Total Kjeldahl Nitrogen (TKN), mg/L	Quarterly	Grab
Chloride, mg/L	Quarterly	Grab
E-Coli Bacteria, organisms/100 ml	Quarterly	Grab
Specific Conductance, umhos/cm	Quarterly	Grab
Total Phosphorous (TP), mg/L	Quarterly	Grab
Total Nitrogen, as N (TN), mg/L	Quarterly	Calculated

<sup>(1)</sup> See definitions, Part V. of the permit.

The monitoring of chloride and specific conductance is used as indicators of potential impacts from the wastewater to the ground water.

Ground water sample collection, preservation and analysis shall be conducted according to ARM 17.30.1007 and “Non-Point Source Water Quality Standard Operating Procedures” (4/1/95) at <http://deq.mt.gov/wqinfo/monitoring/SOP/pdf?10-0.pdf> until the permit is issued. No later than 60 days from the date of permit issuance, the permittee shall develop and maintain onsite a revised site specific Standard Operating Procedure (SOP) manual and a Sampling and Analysis Plan (SAP) for monitoring and sampling the ground water monitoring wells.

#### D. Corrective Action – Ground Water Trigger Values

The trigger values for ground monitoring well MW1A and MW2A are listed in Table 14. An exceedance of a trigger value for either E-coli bacteria or nitrate (as N) will require a re-sample be collected from the monitoring well(s) within 72 hours of the laboratory notification of the analytical results from the scheduled sampling event. Corrective action will need to be implemented should the analytical results from the re-sample verify the exceedance(s).

**Table 14. Ground Water Trigger Values for Monitoring Well MW1A and MW2A**

Parameter, units	Trigger Value
E-Coli Bacteria, organisms/100 ml	Equal to or greater than 1
Nitrate (as N), mg/L	7.5

Ground water corrective action could involve but not be limited to, one or more of the following measures based on the nature and extent of the potential impacts to the ground water quality.

- Identification of the probable cause and extent of the ground water quality changes.
- Installation of additional ground water monitoring wells, including an upgradient well.
- Increased sampling (frequency and/or constituents).
- Increase the efficiency of the wastewater treatment system.
- Reduce the amount of nutrients or other parameters discharged into the ground water.
- Addition of disinfection to the effluent prior to discharge, if the E-coli bacteria trigger value was exceeded.

## XI. NONDEGRADATION SIGNIFICANCE DETERMINATION

The Department has determined the existing discharge is nonsignificant and there will be no degradation of state waters [Montana Nondegradation Policy [75-5-303, MCA; ARM 17.30.702(16)]. The applicable water quality standards for Class I ground water are summarized in Table 5. The effluent limits for TN and TP are based on compliance with water quality standards. The proposed discharge will not exceed the water quality standard for nitrate (as N) of 7.5 mg/L at the hydraulically downgradient boundary of the 140-foot ground water mixing zone for Outfall 003C and the two 220-foot mixing zones for Outfalls 001A and 002B, each.

## XII. INFORMATION SOURCES

In the development of the effluent limitations, monitoring requirements and special conditions for the original permit and the draft permit renewal, the following information sources were used to establish the basis of the draft permit and are hereby referenced:

ARM Title 17, Chapter 30, Sub-chapter 5 - Mixing Zones in Surface and Ground Water, September 1999.

ARM Title 17, Chapter 30, Sub-chapter 7 - Nondegradation of Water Quality, March 2000.

ARM Title 17, Chapter 30, Sub-chapter 10 - Montana Ground Water Pollution Control System (MGWPCS), March 2002.

Baldwin, David O., Hydrogeologic and Hydrochemical Investigation of the Big Sky Area, September 1996.

C & H Engineering, "Significance Determination Non Degradation Report for Firelight Meadows Development, Gallatin County, MT", June 2000.

Cherry, J.A. and Freeze, R. A., 1979, *Groundwater*. Prentice-Hall Inc., Englewood Cliffs, - 20 - J.J. Chapter 2, pages 26-29.

DEQ Circular 4, February 2006.

DEQ Circular 7 – Montana Numeric Water Quality Standards, February 2006.

DEQ, "How to Perform a Nondegradation Analysis for Subsurface wastewater Treatment Systems (SWTSs)", March, 2005.

DEQ, Memo-Regensburger, "Revised Modification of Phosphorous Concentration for Domestic Sewage in Nondegradation Reviews," October 29, 1998.

DEQ, "Nitrate Sensitivity Analysis Input Data", 1994.

DEQ, "Non-Point Source Water Quality Standard Operating Procedures" (4/1/95) at [www.deq.state.mt.us/wqinfo/monitoring/SOP/Sap.asp](http://www.deq.state.mt.us/wqinfo/monitoring/SOP/Sap.asp)

DEQ, Regensburger, Statement of Basis and Permit for Firelight Meadows Subdivision, SOB December 2001, permit January 2002.

GWIC Database, <http://mbmggwic.mtech.edu>

Hovde, Richard, “Non-compliance letter” to DEQ (Jeff may), October 4, 2007.

Land & Water consulting, Inc., “Quantitative Ground water Flow Model for the Hellgate Valley,” December 1994

Natural Resources and Conservation Service (NRCS), Missoula County Area, Montana, April 12, 2006.

U.S. Environmental Protection Agency, Rev September 2000. U.S. EPA NPDES Permit Writers’ Course, Helena, Montana, September, 2000, Workbook EPA 833-B-97-001.

U.S. Environmental Protection Agency, February 2002. *Design Manual: Onsite Wastewater Treatment and Disposal System*. EPA 625/R-00/008, p. 3-29 (Table 3-19) and Fact Sheet TFS-9 “Fixed Film Processes”, and Table 1, TFS-51.

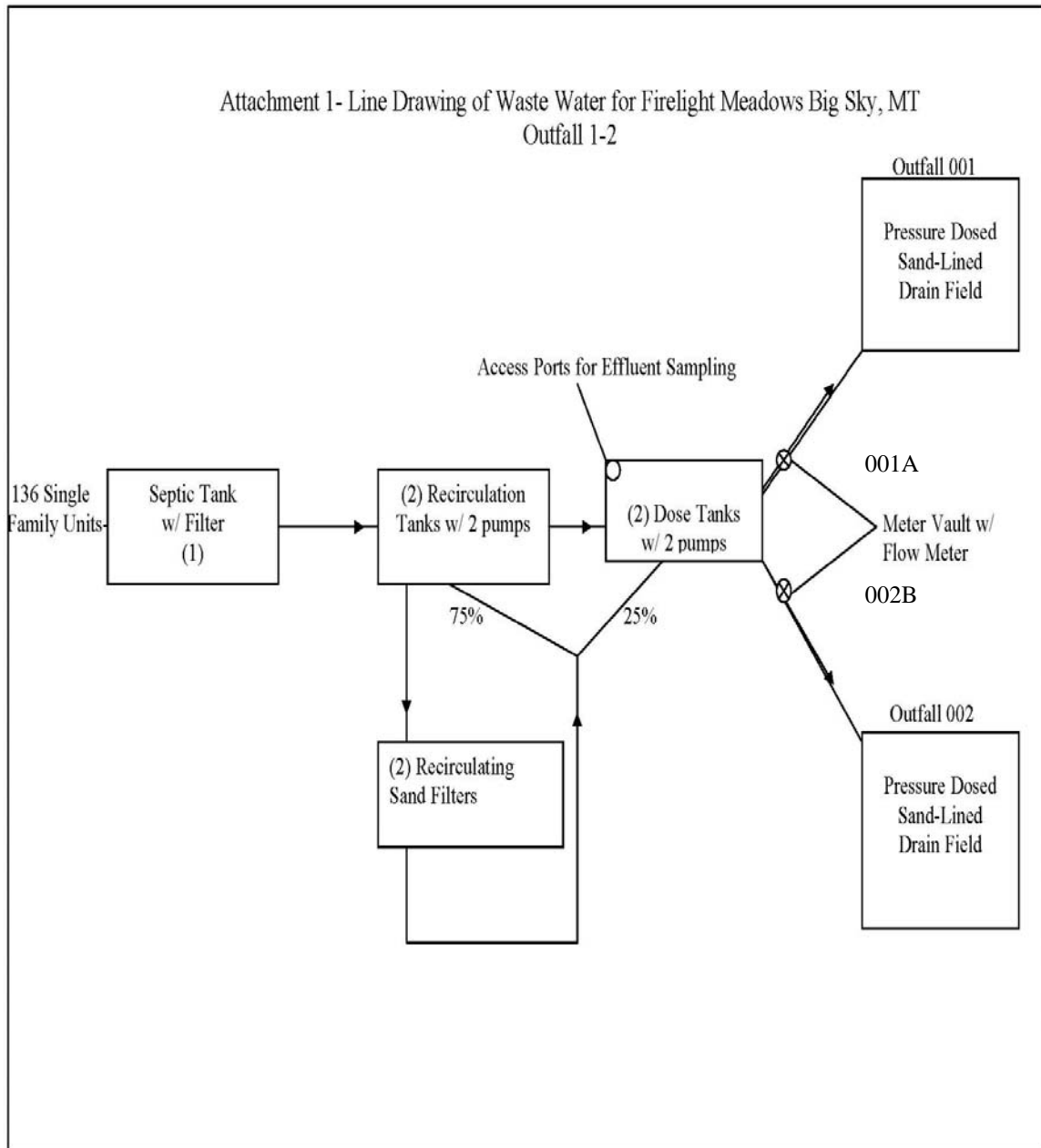
### XIII. ATTACHMENTS

Attachment 1 - Wastewater Flow Line-Diagram for Outfalls 001A and 002B

Attachment 2 – Wastewater Flow Line-Diagram for Outfall003C

**Prepared by:** Pat Potts

**Date:** October 29, 2007



Outfall 001A

Attachment 2- Line Drawing of Waste Water for Firelight Meadows Big Sky, MT  
Outfall 3

